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Commercial Application for Combat Effectiveness (CACE)

AFTER INITIATIVE REPORT



Kenney Class Initiative

**Air Force Space Battlelab
730 Irwin Ave, Ste 83
Schriever AFB CO 80912-7383**

June 1999

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REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
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1. REPORT DATE (DD-MM-YYYY) xx-06-1999		2. REPORT TYPE Technical Publication (Report)		3. DATES COVERED (From - To) 01-12-1997 to 01-06-1999	
4. TITLE AND SUBTITLE Commercial Application for Combat Effectiveness (CACE)				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Oran, Tim; Author				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Space Battlelab 730 Irwin Ave, Ste 83 Schriever AFB, CO 80912-7383				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Space Battlelab 730 Irwin Ave, Ste 83 Schriever AFB, CO 80912-7383				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT A Approved for public release; distribution is unlimited.					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT This after initiative report is a summary of extensive data gathered by the Air Force Space Battlelab during the evaluation of the Iridium Satellite System. For this evaluation, the Air Force Space Battlelab interviewed Commander-in-Chief (CINC) J6 staffs and warfighters in the field. The Air Force Space Battlelab also reviewed current Joint Operations Requirements, Joint and Services Concepts of Operations, and future military communication needs. This global evaluation used over 21,000 minutes of airtime on the Iridium system in 40 days.					
20000103 071					
15. SUBJECT TERMS Iridium, Satellite Communications, Mobile Satellite Service (MSS)					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same As Report	18. NUMBER OF PAGES 15	19a. NAME OF RESPONSIBLE PERSON MSgt Joel Stolzmann
a. REPORT UNCLASSIFIED	b. ABSTRACT UNCLASSIFIED	c. THIS PAGE UNCLASSIFIED			19b. TELEPHONE NUMBER (include area code) 719-567-9992

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EXECUTIVE OVERVIEW

Commercial Applications for Combat Effectiveness (CACE)

The purpose of this report is to present the findings of the Air Force Space Battlelab's evaluation of the Iridium Satellite Communications System. We also make written recommendations for implementation, operations, and management of these systems.

This after initiative report is a summary of extensive data gathered by the Air Force Space Battlelab during the evaluation of the Iridium Satellite System. For this evaluation, the Air Force Space Battlelab interviewed Commander-in-Chief (CINC) J6 staffs and warfighters in the field. The Air Force Space Battlelab also reviewed current Joint Operations Requirements, Joint and Services Concepts of Operations, and future military communication needs. This global evaluation used over 21,000 minutes of airtime on the Iridium system in 40 days.

The views and opinions illustrated in this report are those of the Air Force Space Battlelab. The information contained in this paper has been presented to the Chief/Director, House Appropriations Committee, Surveys and Investigations; National Satellite Communications and Communications Senior Steering Group; Joint Chief's of Staff/J6; Air Force Requirements Oversight Council; US Space Command/J6; Air Force Space Command General Officer Advisory Group; Motorola, and Iridium North America.

In the words of Dick Chaney, Former Secretary of Defense, *"Advanced technologies can make third-class powers into first-class threats."* Today with the invention of commercial mobile satellite communication systems, his words ring true. Rapid advancements in technology are creating revolutionary breakthroughs in the communications world. Commercial interests are driving technology development, especially in space and information systems. High-speed, high-volume telecommunications, coupled with advances in miniaturized computing are enabling vast, interactive information databases on globally networked computers. Research shows military resources will shift from sustaining systems and research and development to buying and leasing state of the art services.

According to the Department of Defense, Advanced Military Satellite Communications Capstone Requirements Document, dated 24 Apr 98, *"Today's legacy MILSATCOM systems are unable to meet many of today's requirements.... With only current capabilities, the warfighters connectivity will be a major limiting factor in the effective application of combat power in future conflicts."*

The Defense Planning Guidance FY95 – FY99 requires initiatives to pursue and leverage new technologies that enhance the Department of Defense operation capability. The CACE initiative demonstrates the Iridium system meets this objective. The DOD should take full advantage of commercial technological advances like Iridium now and minimize expensive and unsupportable stovepipe facilities and equipment.

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LIST OF PRIMARY EVALUATION PARTICIPANTS

(This is not an all inclusive list of participants)

US Atlantic Command
US European Command
 Combined Task Force Operation Northern Watch
US Central Command
US Pacific Command
 Alaskan Command
 Joint Task Force Full Accounting
US Special Operations Command
US Transportation Command
US Space Command
US Strategic Command
US Southern Command
US Army
 Army Space and Missile Defense Battlelab
 3rd Army
US Navy
 SPAWAR, San Diego
US Air Force
 Air Force Communications Agency
 Air Force TENCAP
 Air Force Organization for Test and Evaluation
 Air Force Space Warfare Center
 Air Force 76th Space Operations Squadron, AF Space Support Teams
 Air Force 10th Space Warning Squadron
 Air Force 12 Space Warning Squadron
US Marines
US Coast Guard
US Customs Agency
Central Intelligence Agency
Federal Emergency Management Agency
Office of the Joint Chiefs of Staff
The National Reconnaissance Organization
White House Communications Agency
Defense Information Systems Agency
National Security Agency
Office of the Secretary of Defense
Special Operations from all Services
Massachusetts Institute of Technology/Lincoln Laboratory
Scitor Corporation
MITRE
Motorola
Iridium

AFTER INITIATIVE REPORT FOR KENNEY BATTLELAB INITIATIVE Commercial Application for Combat Effectiveness (CACE)

1. EVALUATION MISSION STATEMENT

a. Purpose

The purpose of the CACE initiative was to explore the value added in using Commercial Mobile Satellite Systems (MSS) to augment DoD communication needs. The Air Force Space Battlelab accomplished this evaluation by using the Iridium Communication System and evaluating the performance of the system on a global scale. For example, the Massachusetts Institute of Technology evaluated the system using a floating buoyant cable off the northern coast of Alaska to demonstrate the system's ability to support submarine operations.

b. Problem

Military satellite communications (MILSATCOM) today is a collection of systems that provide particular services to users. Unfortunately, warfighter communication requirements far exceed these systems capabilities. The gap between requirements and projected MILSATCOM capacity widens in the future. Only by leveraging new commercial communication technologies will the DoD be able to narrow the gap and provide the required bandwidth.

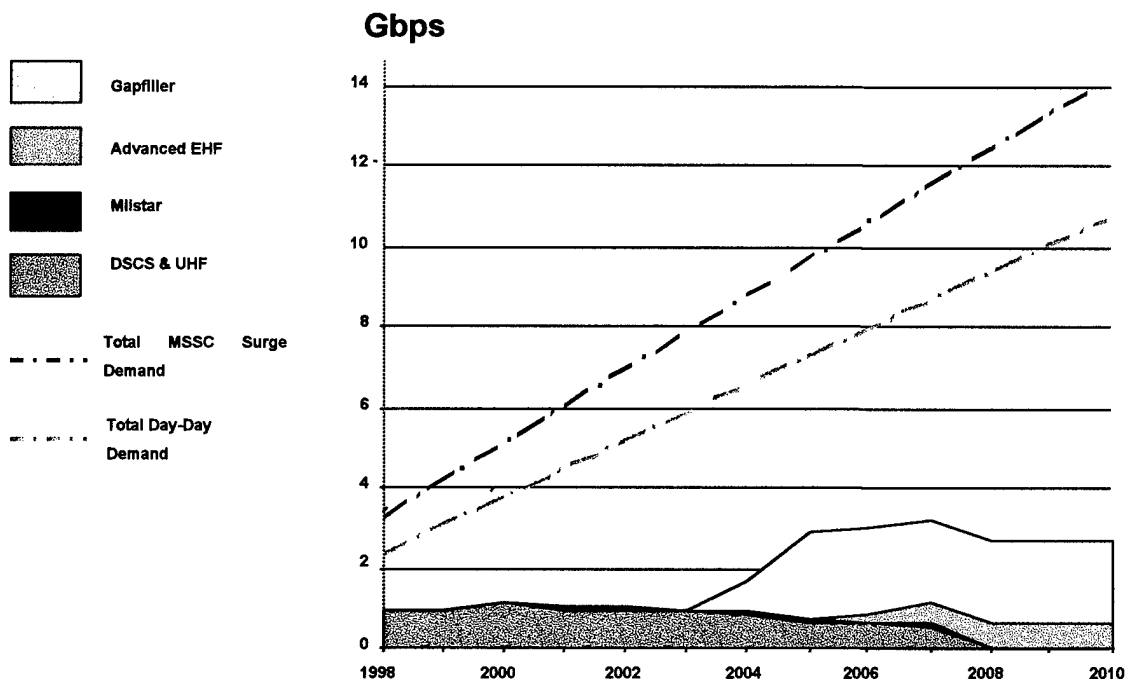


Figure 1. Current and Projected MILSATCOM Capabilities
(Source: USSPACECOM/J6S)

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c. Objective

The objective for the CACE initiative was to explore the value added in using commercial MSS to augment DoD communication needs. This objective was met by evaluating the Iridium system globally and using the system for more than 21,000 minutes in a 40-day period.

The Measures of Merit (MOM) used were the critical mission areas specified in the Joint Concept of Operations for Mobile Satellite Services. Evaluation findings are in section 3, Results.

d. Time Required**1. Submittal of Battlelab Initiative to Approval**

The Space Battlelab presented the CACE concept to the Battlelab Planning Cell (BPC) Nov 97. The Air Force Space Battlelab General Officer Advisory Group (GOAG) approved the CACE concept for detailed planning Dec 97 and for execution May 98. The Space Battlelab received \$80K for execution from the GOAG.

2. From Approval to Completion

The CACE initiative began May 98 and was completed May 99.

A. Jun - Jul 98	Ulchi Focus Lens Planning for Evaluation
B. Jul 98	Iridium Beta Trials delayed until Nov 98
C. Nov - Dec 98	Field Evaluation and Data Collection
D. Jan - Apr 99	Final Evaluation and Data Collection
E. May - Jun 99	Detailed Data Analysis and Report Preparation

2. COURSE OF ACTION**a. Overview**

Capt Timothy W. Oran of the Air Force Space Battlelab worked with LCDR Cynthia Anderson, CDR Herb Yee, and LTC Jose Carrington, US Space Command/J6S; Lt Col George Fields, Joint Staff/J6T; Mr. Pat Armstrong, Motorola Worldwide Information Network Services; and Mr. Stuart Fankhauser, Iridium North America to conduct this worldwide Iridium evaluation. The demonstration team was responsible for logistical coordination to include scheduling, transportation of all equipment, approval to operate in host nations, training, and development of the CACE evaluation survey. The Scitor Corporation performed the data collection and analysis of over 130 evaluation surveys.

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b. System Description

The Iridium system is a satellite-based, wireless personal communications network designed to permit any type of telephone transmission – voice, data, fax, or paging – to reach its destination anywhere on earth. The Iridium constellation consists of 66 interconnected satellites orbiting 420 nautical miles above the earth. The system can simplify communications for National Agency and DoD users who need the features and convenience of a wireless handheld telephone for worldwide use. During this evaluation, the Iridium system could only support non-secure voice communications. Type 1 secure voice communications and data capabilities are projected for May '00.

c. Analysis

When we began the Beta trial, the Iridium system was a maturing satellite communications system with the potential to provide incredible flexibility to DoD and National users. When the evaluation began, call completion rates averaged approximately 56 percent. Several factors contributed to this initial unsatisfactory result. First, the beta handsets had hardware problems that caused call drops and degraded the voice quality. Second, the Iridium system was in beta development and still not fully operational. Third, some users had difficulty operating the handsets because of a complex handset menu system, users' manual, and little formal training.

The Iridium system is 100 percent operational today. Call completions for the Iridium system now average approximately 98 percent, which exceeds the Operational Requirements Document (ORD) threshold of 90%. Hardware and software changes made to the Iridium system and handsets since the initial evaluation now make the system an appealing option for the DoD and National user. *(Specific classified Iridium evaluations are available from the Air Force Space Battlelab)*

3. RESULTS.**a. Summary**

Our worldwide evaluation demonstrated the Iridium system is very capable of providing communications to the DoD. In this study, the Air Force Space Battlelab assessed the use of this commercial satellite communications system in supporting critical mission areas identified in the Joint Concept of Operations for Mobile Satellite Systems. We believe this evaluation demonstrates that the commercial satellite communications providers like Iridium are the foundation needed for the DoD to move to a Network-Centric, Global Grid Information Architecture.

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Emerging Commercial Satellite Services to Bridge the MILSATCOM Gap

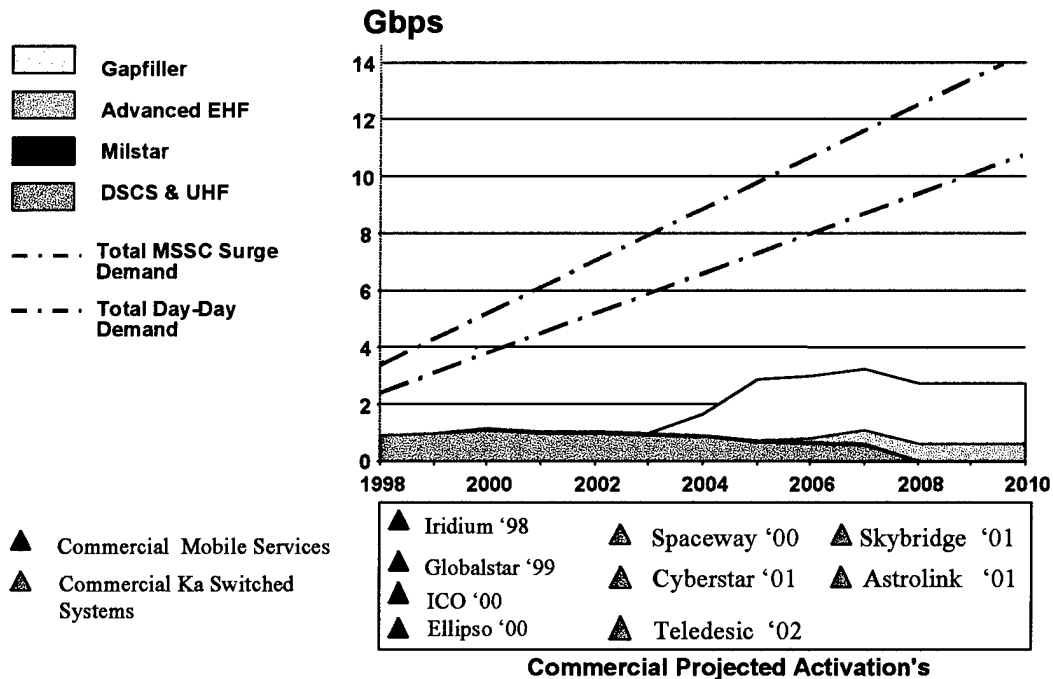


Figure 2. Emerging Commercial Satellite Services
(Source: USSPACECOM/J6S)

Although the Iridium system evaluation took place during the beta phase of system development, Iridium clearly proved it could provide communications around the world from pole-to-pole and in the open oceans with minimal ground infrastructure (e.g., gateway in Hawaii or Arizona). This brings the DoD to a point where over-the-horizon communication issues can possibly be resolved. For the first time, the DoD could realize a truly seamless ground, air, sea, and space communications architecture.

The evaluation clearly demonstrated that user training is crucial. The Iridium system is different from any telephone system ever developed. In most cases, 30 minutes of training or less is all that is necessary to be functional on the Iridium system. Although the Air Force Space Battlelab and Motorola conducted two train-the-trainer classes, it was not enough. In every instance where a caller reported a "hardware problem" and no hardware problem could be validated, we

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subsequently found that by talking the user through the dialing sequence the "hardware problem" was suddenly solved. The Iridium system introduces an entirely new way of making telephone calls and this requires focused training to ensure success.

The Air Force Space Battlelab traveled worldwide talking to warfighters at all levels. Incredibly, what we found was a lack of communications capability to complete the mission. One question we asked every commander is ***"What is more important to the success of your mission, communications capability or communications security?"*** In every case, the answer was ***"Communications capability is number one. While security is an important issue, there is no issue if I can't communicate with my troops for force protection and command and control."*** Commanders also want and need the ability to make decisions regarding communications at their level. It is important for commanders to have the flexibility to react quickly to changing operational requirements. Technology is changing too rapidly to predict all future requirements. The DoD should create flexible policies to allow commanders' the authority to purchase locally. Flexible policies will also give commanders the ability to leverage economies of scale, when possible. This is critical in Europe today; however, these commanders feel they are hampered by the lack of smart policies and no authority to purchase locally.

b. Objective

The objective for the CACE initiative was to explore the value added in using commercial Mobile Satellite Services to augment DoD communication needs, with emphasis on Situation Awareness, Reachback, and to minimize the in theater footprint of required communications support equipment. Current and future DoD communications needs exceed DoD organic SATCOM capacity present and future.

c. Measures of Merit and Findings

The rating scale used for the evaluation relative to the measures of merit was Low, Medium, High, and Very High. The Air Force Space Battlelab also factored in the projected release of the Iridium Type 1 secure module (May '00) when evaluating mission supportability.

1. Theater Ballistic Missile Warning (TBMW) non-secure notification

Findings (Medium): Working with the Army Space and Missile Defense Battlelab, we determined the Iridium Paging system was not mature enough to support this mission area. This evaluation did demonstrate Iridium's capability to provide notification to the lowest levels of command and control with no terrestrial infrastructure. The evaluators identified notification delays of 40 seconds to 4 minutes.

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Motorola has now determined that these delays can be solved with a trade off between battery life and more frequent pager contact by the Iridium system. This issue is scheduled for re-evaluation at Exercise Roving Sands '99.

2. Combat Search and Rescue

Findings (Very High): During follow-up of the Iridium evaluations with the Combined Task Force (CTF) Operation Northern Watch, the Iridium system continues to provide real-time operational support using non-secure voice communications for search and rescue. Initial concerns for secure only communications prove secondary to communications capability. According to Brigadier General Deptula, Operation Northern Watch Commander, ***"I must have the ability to communicate with my personnel to provide effective force protection and combat search and rescue. Secure communications, while a concern, is secondary to ability to communicate. I must also have the ability to leverage this type of technology rapidly. No one knows our requirements better than we do."*** This CTF now has the capability to perform command and control where it did not exist before. The Iridium system clearly supports their mission and adds flexibility. The Iridium system is also a potential option for providing interim capabilities to pilots until C-SEL type applications are ready for fielding. We demonstrated the handset worked well inside a gold canopy F-16. Successful calls were made to and from this airframe while on the ramp at Nellis AFB, NV.

3. Non-Combatant Evacuation Operations (NEO)

Findings (High): The Iridium system provides immediate cross functionality with all forms of voice communications. For the first time, the DoD now has the capability to communicate via voice with civil, National, and other DoD agencies with one system. This system also provides the capability to communicate outside the Iridium system to the public switch telephone network, Defense Switch Network, and all other satellite communication providers. By adding the terrestrial cellular module (an accessory), the DoD now has the ability to dial one telephone number and connect via cell or satellite communication systems using Iridium handsets.

4. Special Operations

Findings (High): During the Iridium evaluation, we flew with the 10th Special Forces Group from Fort Carson, CO on a mission to scout locations for winter training in the Rocky Mountains. We traveled in an MH-47 and noted the capability to receive pager notifications while in flight. We also noted the ability to make Iridium telephone calls, but could

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not overcome the noise factor using a standard Iridium handset. A noise-canceling headset is required for use while in flight. While on the ground, the Iridium handset was used to report training site locations using GPS coordinates and to provide mission flight changes to the command center at Fort Carson. The Iridium system provides flexibility to perform mission requirements not seen before with MILSATCOM. The Special Operations community believes the Iridium system will be extremely beneficial for their air and ground forces. As the Iridium system matures and the handset becomes smaller and has a secure communications capability, it is possible that Iridium could replace MILSATCOM within the Special Operations community.

5. Strategic Airlift and Force Sustainment Activities

Findings (High): The Iridium system provides immediate communications capability from anywhere in the world and this is an important factor in providing strategic airlift. Iridium type systems eliminate the requirement for in place ground infrastructure when performing these missions. Furthermore, if the DoD invests in the airframe integration packages available on the commercial market, it can overcome the over-the-horizon issues that challenge the DoD today. The Air Force Space Battlelab also participated in the beta evaluations of the airframe antenna systems. What we found is the external antenna provides quality voice performance. Evaluations of the Iridium handset with no external antenna were performed in several US locations and proved successful if the handset was located near a window on the aircraft while in flight.

6. VIP Travel

Findings (Very High): Iridium with its accessories supports this mission very well. General Myers, Commander-in-Chief, US Space Command, used the Iridium system during a trip to the Pacific Rim. We configured his Iridium handset with a GSM cellular module to provide both cellular and satellite capabilities. According to the communication support staff, the Iridium system provided great support, especially in areas not otherwise covered by current communication systems. The flexibility Iridium provides for DoD VIP travel is tremendous when used with available Iridium accessories. The system performed well onboard his C-21 aircraft with no external antenna.

7. Humanitarian/Disaster Relief Support

Findings (Very High): This mission area was evaluated extensively during Hurricane Mitch relief efforts. US Southern Command used the Iridium system to support their real-world operations in Central America

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where countries were devastated by this hurricane. The system provided immediate communications capability to coordinate relief efforts, medical triage and treatment, etc.

8. Polar Region Coverage

Findings (Very High): This mission area was assessed at both Polar Regions. Iridium handsets were transported to Thule AB, Greenland, located approximately 76.3° north. The call location at Thule was inside one of the operations buildings near a window. The weather conditions at Thule prohibited outside calling, but did not prevent successful call completions to Schriever AFB, CO. This phase of the evaluation exceeded the ORD threshold requirements for providing support above or below the 65th parallels.

The Massachusetts Institute of Technology/Lincoln Laboratory participated in the demonstration from Kotzebue, Alaska, located 25 miles north of the Arctic Circle. This evaluation consisted of attaching an L-Band buoyant cable antenna to the Iridium handset to determine utility for submarine satellite communications. The demonstration of this prototype L-band antenna was very successful. From a qualitative perspective, there was no way to distinguish the buoyant cable from the built-in handset antenna.

Use of the Iridium handset in Antarctica was evaluated with the assistance of Air Force TENCAP and the Chilean Air Force. The Iridium system provided en-route communications capabilities for tracking the Chilean Air Force Chief of Staff. During this evaluation, voice quality was generally very good, but users did experience some system problems that caused calls to drop without notice. Motorola has now resolved these problems, and Iridium service is available in Antarctica.

4. RECOMMENDATIONS.

a. Training

As previously identified, training is key to successful use of the Iridium system. There are two ways to conduct this training. First, personal training in a classroom setting for train-the-trainer or individual sessions. Second, use of computer-based or video training produced by Motorola. This training CD and video are available at no additional charge from Motorola.

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b. Policy for using Mobile Satellite Services

Write a smart policy that provides flexibility for commanders to meet changing mission requirements. This policy should give commanders the ability to use local procurement avenues for satisfying immediate requirements. By giving commanders the authority to leverage commercial technology at the local level, they are empowered to meet mission requirements with no delays. MILSATCOM alone no longer can satisfy the DoD requirements and thus, flexible, mission supportive policies that provide for maximum use of commercial systems are recommended. The MSS policy should also consider allowing NATO and Allied Forces access to using the DoD gateway for interoperability.

c. Non-Secure vs. Secure only Communications

During peacetime operations, approximately 85 percent of all communications are non-secure. During contingency support, this number is approximately 75 percent. These figures indicate the primary use of all communications is non-secure and therefore, DoD should not limit the use of the Iridium system to classified use only. Commanders indicate that security is secondary to capability and by requiring the purchase of securable handsets, we eliminate a large set of potential users from the DoD gateway. The operations and maintenance costs for the DoD gateway are forecast at greater than \$15 million a year; and if the DoD does not have users registered through this gateway, the DoD must absorb the operations and maintenance costs. Large numbers of potential National users (e.g., FAA, NASA, FEMA, etc.) do not require secure capability. Participation by non-DoD users is an excellent way to offset DoD costs for maintaining the DoD gateway. ORD requirements are for the DoD gateway to support Type 1 security when necessary.

d. Direct billing from Motorola to the end user

Motorola is the current vendor responsible for billing the Defense Information Systems Agency (DISA) for any use of the DoD gateway. If the DoD permits Motorola to direct bill the end user, with a copy of all charges sent to DISA for financial reimbursement monitoring, we could eliminate one layer of the billing system. By doing this, the DoD has one less system to provide administrative support to, thus saving countless taxpayer dollars. The DoD would save money by letting the commercial vendor who is entrusted to maintain the system and bill the government, to bill direct to the end user. This is only one of the benefits the DoD realizes by leveraging commercial satellite technology and practices.

e. Use Blended Rates

The current billing system uses a complex matrix system to determine how much each call costs. This system is so complex that even some managers of the system can not explain it. What we propose is a system using blended rates

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for all call charges. Blended rates are based on average costs. For example, all calls within the United States would be 10 cents a minute and international calls would be \$3 a minute. This technique eliminates the confusing matrix billing system, makes the system easier to manage, and saves the government money in administrative overhead.

f. Control Access to the DOD Gateway Through Motorola

By using Motorola to control access, the DoD can create a one stop shopping system that commanders can leverage with local procurement procedures. This will provide the flexibility commanders need to meet mission requirements. The DoD can support this function using DISA or the JS/J6 offices to validate access requirements when in question. During normal situations, a listing of authorized agencies or users could be given to Motorola. This will enhance the systems' ability to respond to immediate requirements.

g. Lease vs. Buy

Current policy requires all users to obtain their hardware through DISA as a sole source. This process is slow and not cost effective for all potential DoD users. There are no avenues to leverage economies of scale or to fill immediate requirements. Also, current policy requires the purchase of securable handsets, and those are not available until May '00. Since the DoD gateway has been operational since Nov 98, this is not cost effective for the DoD. Recommend pursuit of a lease option to obtain the non-secure version of the Iridium handset with replacement, upgrades, and maintenance built into the lease. Currently, sustainment of the handset is an additional cost the user must acquire under separate contract. Perhaps an all-in-one package that includes all the aforementioned recommendations and a set amount of airtime per month would be appealing to DoD and National users.

h. Evaluate the use of Iridium in High Performance Airframes

The Iridium system offers a possible solution to DoD over-the-horizon communication problems. The Air Force Space Battlelab, Command and Control Battlelab, and the Air Expeditionary Forces Battlelab should pursue a demonstration.

i. Continue Action to Leverage the Multi-Billion Dollar Commercial Satellite Communications Industry to Provide Communications to the Warfighter

New commercial technology can possibly replace military stovepipe communications systems in many areas. Some possibilities are the Air Force Satellite Control Network (AFSCN) communications upgrade, Over-the-Horizon communications, and all non-secure administrative requirements.

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5. CONCLUSION.

This Air Force Space Battlelab initiative was a very successful demonstration, which should directly and significantly affect DoD policy for acquiring Commercial Mobile Satellite Services. As we move into the future with space-based more capable communications and develop a Network-Centric, Global Grid Information Architecture, it is clear Iridium and other mobile satellite services are a step towards this end.



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